

Claims

1. A polynucleotide sequence which encodes a HPV amino acid sequence,
wherein the codon usage pattern of the polynucleotide sequence resembles that of
highly expressed mammalian genes.
2. The polynucleotide sequence according to claim 1 in which the codon usage
pattern of the polynucleotide sequence resembles that of highly expressed human
genes.
3. The polynucleotide sequence according to claim 1 in which the codon usage
pattern of the polynucleotide sequence also resembles that of highly expressed
E. coli genes.
4. The polynucleotide sequence according to claim 1 which is a DNA sequence.
5. The polynucleotide sequence according to claim 1 which encodes a HPV
polypeptide of an HPV type or sub-type associated with cervical cancer, benign
cutaneous warts or genital warts.
6. The polynucleotide sequence according to claim 5 which encodes a HPV
polypeptide of one of types 1-4, 6, 7, 11, 16, 18, 26-29, 31, 33, 35, 39, 45, 51,
52, 56, 58, 59, and 68.
7. The polynucleotide sequence according to claim 6 which encodes a HPV
polypeptide of an HPV type or sub-type which is associated particularly with
cervical cancer or genital warts.
8. The polynucleotide sequence according to claim 7 which encodes a HPV
polypeptide of one of types 6, 11, 16, 18, 33 or 45, or a fusion of two or more
polypeptides of one or more of HPV virus types 6, 11, 16, 18, 33 or 45.

9. The polynucleotide sequence according to claim 8 which encodes a HPV polypeptide of a HPV type or sub-type selected from HPV 11, 6a or 6b.
10. The polynucleotide sequence according to claim 1 which encodes a mutated HPV polypeptide having reduced biological function.
11. The polynucleotide sequence according to claim 10 which encodes a mutated HPV polypeptide comprising one or more point mutations by which one or more of the polypeptide's natural biological functions is inactivated.
12. The polynucleotide sequence according to claim 1 in which the encoded HPV polypeptide comprises the whole or a part of a HPV early gene product.
13. The polynucleotide sequence according to claim 12 in which the encoded HPV polypeptide comprises the whole or a part of E1 or E2, or a fusion of the whole or a part of E1 or E2 with another HPV polypeptide.
14. The polynucleotide sequence according to claim 2 having a codon usage coefficient for highly expressed human genes of greater than 0.3 but less than 1.
15. The polynucleotide sequence according to claim 2 having a codon usage coefficient for highly expressed human genes of greater than 0.4 but less than 1.
16. The polynucleotide sequence according to claim 2 having a codon usage coefficient for highly expressed human genes of greater than 0.5 but less than 1.
17. The polynucleotide sequence according to claim 3 having a codon usage coefficient for highly expressed E. coli genes of greater than 0.6.
18. A polynucleotide sequence as set out in Fig. 5a and 5b, or a fragment or analogue thereof which maintains the codon usage pattern thereof.

19. A polynucleotide sequence as set out in Fig. 6, or a fragment or analogue thereof which maintains the codon usage pattern thereof.

20. An expression vector comprising a polynucleotide sequence according to claim 1 operably linked to a control sequence which is capable of providing for the expression of the polynucleotide sequence by a host cell.

21. The expression vector according to claim 20 which is capable of directing the expression of the polynucleotide sequence in bacterial, insect or mammalian cells.

22. The expression vector according to claim 20 which is p7313PLc.

23. A host cell comprising a polynucleotide sequence according to claim 1.

24. A host cell comprising an expression vector according to claim 20.

25. A host cell according to claim 23 or claim 24 which is a bacterial, mammalian, or insect cell.

26. A pharmaceutical composition comprising a polynucleotide sequence according to claim 1.

27. A pharmaceutical composition comprising a vector according to claim 20.

28. A pharmaceutical composition according to claim 26 or claim 27 comprising a plurality of particles, preferably gold particles, coated with DNA.

29. A pharmaceutical composition according to claim 27 further comprising a pharmaceutically acceptable excipient.

30. A pharmaceutical composition according to any one of claims 26, 27, or 29 further comprising an adjuvant.

31. A pharmaceutical composition according to claim 28 further comprising an adjuvant.

5 32. A pharmaceutical composition according to claim 30 in which the adjuvant is encoded as a fusion with the HPV polypeptide encoded by the polynucleotide.

33. A pharmaceutical composition according to claim 31 in which the adjuvant is encoded as a fusion with the HPV polypeptide encoded by the polynucleotide.

10 34. A method of treating or preventing HPV infections or any symptoms or diseases associated therewith, comprising administering an effective amount of a polynucleotide according to claim 1, a vector according to claim 20 or a pharmaceutical composition according to claim 26 or 27.

15 35. A method of treating or preventing HPV infections or any symptoms or diseases associated therewith, comprising administering a pharmaceutical composition according to any one of claims 26 or 27 in a prime-boost dosage regime with a recombinant viral vector or non-viral based system comprising a polynucleotide according to claim 1.